Watershed Delineation: Stream Burning

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Automated Watershed Delineation

- Attractive alternative to manual delineation
  - Potentially more objective
  - Repeatable
  - Cost-effective
  - Consistent with other digital data sets

Challenges and Errors

- Many DEMs have difficulty replicating hydrological patterns in flat landscapes
- Stream sampling points must be accurately located in proper relationship to streams and a flow direction grid
- Misalignment with maps of streams and/or agreeing with local topography
- Can lead to different interpretations of within-watershed flow pathways and resulting drainage boundaries

Stream Burning

- Simple algorithm to resolve discrepancies by combining topographic and hydrographic data
  - Ensures that flow is forced to those cells that correspond to the true locations of streams
- Uses a rasterized version of a digital vector hydrography map to lower the relative elevations of stream pixels by a uniform depth
  - Improve how accurately stream position, stream length and catchment boundaries replicate known hydrological conditions
- "Burns" (or excavates) new channels into the DEM to force alignment

Limitations

- Very deep channel excavations can create distorted watershed boundaries
- May result in creation of parallel streams (one original, one excavated) that compete for up slope flow
- Permanently modifies the original DEM
  - Leads to dramatic jump in elevation
  - May affect further analyses such as slope

Stream Burning Example

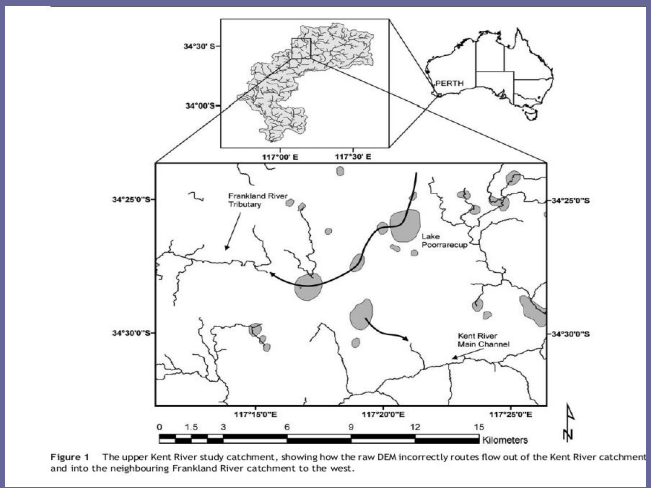


Figure 1 The upper Kent River study catchment, showing how the raw DEM incorrectly routes flow out of the Kent River catchment and into the neighbouring Frankland River catchment to the west.

Raw DEM

Stream Burning Example

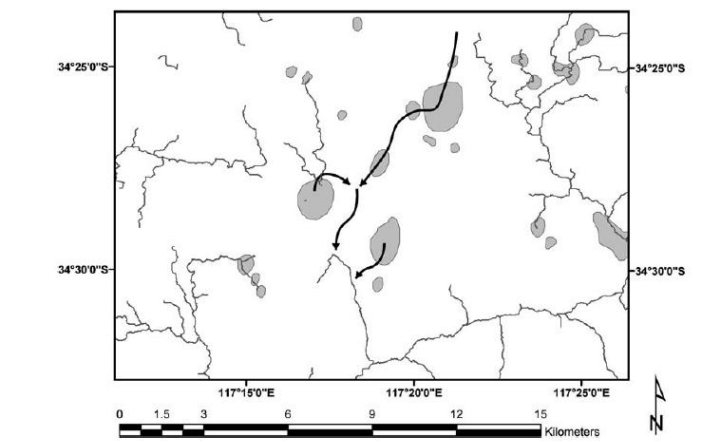
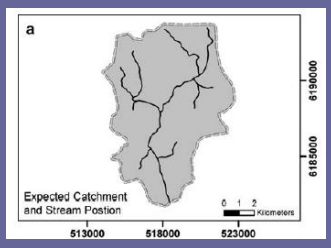
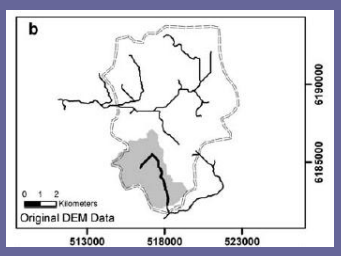


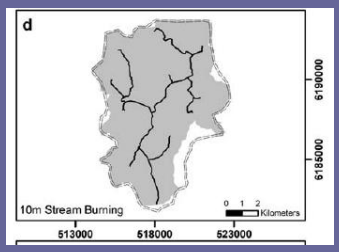
Figure 2 Expected flow directions and catchment boundary from field work and people with expert knowledge.

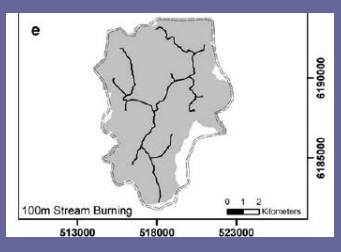
Expert Knowledge

Stream Burning Example









Questions

1. What are the advantages of using an automated watershed delineation like stream burning over manual delineation?
2. What value does stream burning modify during delineation?
3. What are two limitations to the stream burning method?
4. T or F: Stream burning permanently alters the original DEM, which may affect future analyses.

References

- Baker, M., Weller, D., Jordan, T. (2006). Comparison of Automated Watershed Delineations: Effects on Land Cover Areas, Percentages, and Relationships to Nutrient Discharge. *Photogrammetic Engineering & Remote Sensing*. 72(2): 159-168.
- Callow, J., Van Niel, K., Boggs, G. (2007). How does modifying a DEM to reflect known hydrology affect subsequent terrain analysis? *Journal of Hydrology*. 332: 30-39.